# Mini Symposium Recent Advances in Bioimpedance as a Tool for the Assessment of Muscle Condition

Link: https://embc.embs.org/2024/mini-symposia/

## Summary and goals of the proposed Symposium

In developed nations, demographic change is anticipated to influence society and economics in the coming decades. In particular, such aging societies must deal with age-related tissue variations and neuromuscular diseases, most likely challenging the boundaries of the current health care system [1]. Often applied manual diagnosis and therapy monitoring, which is demanding for both patient and therapist, must be replaced with promising alternatives that provide more muscle specificity to address age-related tissue variations, such as Sarcopenia [2].
Recently, Electrical Impedance Myography (EIM), or more specifically bioimpedance measurements of the muscle, has gained interest in the scientific community [3]–[7]. However, the standardization of the applied electrode array, the definition of feasible test protocols, and the interpretation of the acquired EIM measurements are still topics of research [8], [9].
In the future, EIM may address questions about residual muscle activity, muscular force development, and the patient's intention of motion. The participants of this workshop aim to take a first step toward capturing the current state of knowledge about Bioimpedance as a tool for muscle assessment and addressing the challenges this approach is currently facing. Thus, shaping the pathway towards consensus to establish EIM as a new tool for muscle assessment.

## Rationale of the Symposium

**Novelty:** EIM already been established as a tool for the assessment of neuromuscular disorders [10], but its application as a tool for the assessment of muscle activity is not yet established. A consensus for standardization of the applied electrode array, the definition of feasible test protocols, and the interpretation of the acquired EIM measurements is still needed. Moreover, advanced topics such as simultaneous, multichannel measurements along different muscle groups or a combination of Bioimpedance measurements with other measuring modalities, such as ultrasound [11] or Electromyography [12], have not been addressed yet. In the long run, such combinations might have the potential to establish a deeper understanding of dynamic muscle processes such as contraction or morphological changes within the tissue under test.

**Relevance:** In an aging society, age-related tissue variations have the tendency to limit a person's ability to tackle his or her daily living, ultimately resulting in a decrease in quality of life. As engineers, we may retain the capability to handle simple daily challenges, such as taking a walk, by introducing new concepts for a more sophisticated therapy concept and tracking of the applied treatment.

## Contract person information

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# List of contributors providing a presentation

The proposed Mini-Symposium consists of five presentation slots. Each presentation is scheduled for a length of 15 minutes, consisting of 10 minutes of talk time and five minutes for answering questions. To fill up a 90-minute session additional 15 minutes will be used as a buffer and for the collection of the final thoughts of the panel.

**1-st time slot: Presentation** 15 minutes

**Title:** Bioimpedance Myography - a game changer for quantifying muscle condition?

Univ.-Prof. Dr.-Ing. Dr. med. Dr. h. c. Steffen Leonhardt
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**confirmed**

**Abstract:** Bioimpedance Myography gains interest in applications in health, rehabilitation, and physical exercise. Nevertheless, the connection between the Bioimpedance signal and muscle condition -as for instance muscle contraction- is still a topic of research. In his talk, Prof. Leonhardt provides a condensed overview of the state of knowledge about Bioimpedance Myography. The considered topics are contributing factors shaping the signal, disturbances that affect the measurement, and the amount of information obtainable from single, and multi-frequency measuring approaches. Finally, the differences in application of Bioimpedance Myography to smooth and skeletal muscle are considered.

**2-nd time slot: Presentation** 15 minutes

**Title:** Progress and Challenges Applying Bioimpedance for Muscle Quality Assessment

Professor (Associate) Todd J. Freeborn
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**confirmed**

**Abstract:** Localized electrical bioimpedance measurements capture the passive electrical properties of a tissue. Recent outcomes suggest that ultrasound-derived echo intensity (EI), a method to characterize skeletal muscle, and segmental bioimpedance may examine similar aspects of muscle physiology. In his talk, Mr. Freeborn outlines that there has been limited work to translate these measurements into a single metric of muscle quality and to validate that metric to predict performance of skeletal muscle for functional tasks in both controlled and free-living conditions, which requires future work to advance this field.

**3-rd time slot: Presentation** 15 minutes

**Title:** Electrical impedance for assessing the effects of disease and reduced gravity on skeletal muscle

Professor Seward B. Rutkove, MD
Harvard Medical School
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confirmed

**Abstract:** In his talk, Dr. Rutkove will speak on important innovations in the field of electrical impedance in the realm of primary disorders that impact muscle, including muscular dystrophies, amyotrophic lateral sclerosis, and injury. The techniques he will discuss will include surface-based impedance methods as well as an innovative impedance-electromyography electrode that captures simultaneously both the passive (impedance-based) and active (electromyography) elements of muscle activity. Both animal and human data will be presented.

**4-th time slot: Presentation** 15 minutes

**Title:** Application of Bioimpedance Myography as a tool for muscle function testing

Alfred Hülkenberg, M. Sc.
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**Abstract:** State-of-the-art geriatric assessment of the lower extremities is often based on approaches such as the timed-up-and-go (TUG) or chair-raising test. However, such tests lack the ability to perform a thorough assessment of the condition of specific muscle (sub-)groups. In his talk, Mr. Hülkenberg will present a testing environment for the leg extension exercise that enables monitoring of angle, torque, and Bioimpedance signals. Using these, he depicts a reshaping of the Nyquist plot acquired along the rectus femoris muscle during different kinds of muscle activity. Here, a variation of the rotation angle of the knee from flexion to extension. Firstly, without contraction and secondly, with varying contraction intensity.

**5-th time slot: Presentation** 15 minutes

**Title:** Electrical Impedance Myography Application to Stroke Assessment and Rehabilitation

Pan Xu, M. Sc.
College of Physics and Information Engineering
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confirmed

**Abstract:** In her talk, miss Xu Pan will present the application of electrical impedance myography mapping in stroke assessment and rehabilitation. She will discuss how to eliminate the ef-

fect of individual differences in the application of electrical impedance myography mapping in stroke assessment and how to achieve objective evaluation of stroke. The presentation will include clinical cases and comparisons with clinical assessment tools.

**6-th time slot: Buffer and collection of final thoughts** 15 minutes

# List of references

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